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two screws *DD* on the disc *B*, when the bridge can be swung around on *Q* as a center as far as is desired.

To aid in setting the amplitude of the fundamental curve, a series of graduations is provided on a disc carried by the swinging arm *N*, which enables the distance *OQ* to be read off directly (see Fig. 2). Before a curve is drawn, the disc *A* may be rotated so as to begin with any desired phase of the fundamental. Great care has been taken to avoid unnecessary backlash on the part of the various gears, so that the curves are practically free from any irregularity due to this cause.

The two side posts marked *V* in Fig. 2 serve as guides to keep the bar *S* parallel to the paper. The bent rod *E* can be swung around so as to hold *S* in its mean position. A base-line can then be drawn by simply sliding the board along without rotating the discs. In drawing curves before a class, the lecturer stands behind the instrument. For ease in making adjustments, the machine is mounted on a swivel, so that it can be rotated about a vertical axis, adjusted and turned to face the class again. A pencil of soft graphite is most convenient for drawing curves, though a pen can be used. The curves reproduced in Fig. 3 were obtained directly with pens made from glass tubing.

In Fig. 3 I. represents a group of second harmonics of various amplitudes and phases. Any one of these might, of course, be combined with the fundamental curve. In II. the third harmonic is drawn alone, then compounded with the fundamental; and in III. and IV. similar curves for the fifth harmonic are seen.

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QUOTATIONS.

THE TEACHING PROFESSION.

No greater evil could befall the educational system of this country than that of becoming definitely crystallized into the type of organization exemplified by mercantile and corporate enterprise. The evil is imminent, and sometimes seems inevitable, so pervasive are

the influences that tend to make educational administration a matter of business, and so persuasive is the argument from analogy when addressed to ears predisposed by every familiar association to accept its validity. Material and commercial modes of thinking prevail so largely in our national consciousness, and impose themselves so masterfully upon our narrowed imagination, that most people are ready to accept without hesitation their extension into the domain of our intellectual concerns, particularly into that of the great concern of education. Why, it is naïvely asked, why should not the methods that we apply with such pronounced success to the management of a bank or a railway prove equally efficient in the management of a system of schools or a university? Why should there not result from their employment here the same sort of efficiency that results from their employment elsewhere? Why should not the educational fruits of autocratic control, centralized administration and the hierarchical gradation of responsibility and authority be similar to their fruits in the field of commercial activity?

These questions are not difficult to answer, but it is difficult to frame the answer in terms that the successful man of affairs will find intelligible. The subject is one that he approaches with a prejudiced mind, although his bias is not so much due to perversity as to sheer inability to realize the fundamental nature of the question at issue. He is so fixed in the commercial way of looking at organized enterprise that he can not so shift his bearings as to occupy, even temporarily, the professional point of view. Now the idea of professionalism lies at the very core of educational endeavor, and whoever engages in educational work fails of his purpose in just so far as he fails to assert the inherent prerogatives of his calling. He becomes a hireling, in fact if not in name, when he suffers, unprotesting, the deprivation of all initiative, and contentedly plays the part of a cog in a mechanism whose motions are controlled from without. Yet the tendency in our country is to-day strongly set toward the recognition of this devitalized system of educational activity as suitable and praiseworthy, and the

spirit of professionalism in teaching is engaged in what is nothing less than a life-and-death struggle. When a university president or a school principal can indulge unrebuked in the insufferable arrogance of such an expression as 'my faculty' or 'one of my teachers,' when school trustees are capable of calling superintendents and principals and teachers 'employees,' it is time to consider the matter somewhat seriously, and to inquire into the probable consequences of so gross a misconception of the nature of educational service.

There is one general consequence which subsumes all the others. It is that young men of character and self-respect will refuse to engage in the work of teaching (except as a makeshift) as long as the authorities in charge of education remain blind to the professional character of the occupation, and deal with those engaged in it as objects of suspicion, or, at best, as irresponsible and unpractical theorists whose actions must be kept constantly under control and restricted by all manner of limitations and petty regulations. Membership in a profession implies a certain franchise, an emancipation from dictation, and a degree of liberty in the exercise of judgment, which most members of the teaching profession find are denied them by the prevalent forms of educational organization. And the denial is made the more exasperating by the consciousness that these rights (which are elementary and should be inalienable) are withheld by persons whose tenure of authority is more apt to be based upon the executive energy or the ability of the schemer or the success of the man of practical affairs than upon expert acquaintance with the conditions of educational work. The 'business' president or administrative board is bad enough, and the 'political' president or board is worse; yet upon the anything but tender mercies of the one or the other most men who devote their lives to the noble work of teaching must in large measure depend.

The inevitable consequence of this condition is, as we have said, that a process of natural selection is constantly tending to

drive the most capable men into professions which may be pursued upon professional terms, and to make the teaching profession more and more the resort of the poor in spirit, to whom the words of the Beatitude must have a distinctly ironical ring. To become a teacher in this country is, except in the case of a few favored institutions or systems, to subordinate one's individuality to a mechanism, and to expose one's self-respect to indignities of a peculiarly wanton sort. It is no wonder that the young man of parts is not over-anxious to enter a profession so forbidding to every professional instinct, and that he turns aside from the educational field, however strong his natural inclination to enter it, when he gets sight of the artificial obstacles to its proper cultivation.

It is often urged that the money rewards of the teaching profession are insufficient to attract to it the better class of men. This is undoubtedly true up to a certain point, but to insist upon it overmuch is to take a more cynical view of human nature than we are willing to take. Inadequate compensation is a grievous fault of our educational provision, but it is not so grievous as the faults that undermine professional self-respect, and sap educational vitality at its very root. Yet these graver faults are easily remediable, and would be promptly remedied if we could once rid ourselves of the obsession of the commercial or military type of administrative organization. If the educational laborer is worthy of his hire, he is even more worthy of the trust and confidence that necessarily appertain to his delicate and specialized duties, and to refuse him these is to degrade his effort into the mere journeyman's task. The whole question of the relative importance of compensation and consideration was thus stated by one of the speakers at the Illinois Trustees' Conference of last October: "Young men of power and ambition scorn what should be reckoned the noblest of professions, not because that profession condemns them to poverty, but because it dooms them to a sort of servitude. * * * The problem is not one of wages; for no university can become rich

enough to buy the independence of any man who is really worth purchasing."

The more closely the business analogy is examined the more apparent is its failure to fit the conditions of education. Efficiency in business is achieved by the subordination of individual initiative to centralized direction. A highly capable manager makes all the plans, and transmits his ideas, through his heads of departments, to the host of workers, who are expected to do exactly as they are told. Now this arrangement, entirely proper in a department store or a railway company, becomes almost worthless when fitted to a university or a system of public schools, for here the one essential factor of success is that the teachers, who are in this case the host of workers, should be left unhampered by specific directions, and free to apply their own specialized intelligence to their work. Every attempt to shape that work from above, except in such mechanical or formal matters as the allotment of duties and the arrangement of programs, especially every attempt to impose tests or dictate concerning methods, is likely to work direct injury, and is certain in time to eliminate from the body of workers the very persons whom it is most desirable to retain. For it can not be said too often or too emphatically that teaching is the personal concern of instructor and student, and that any meddling with this delicate and intimate relation will work much more mischief than good. So the commercial ideal of high-priced imperious management and low-priced docile labor can have no place in educational work, where the ideal should be rather that of cordial cooperation between all the forces engaged, with the distinct admission that educational policy (as far as such a thing is found desirable) must proceed from the established teaching relation rather than from the doctrinaire mandate of the executive theorist.

We know very well the clamorous objections that will be raised against the fundamental propositions above outlined. 'Chaos is come again' will be the outcry whenever education is sought to be rearranged upon these conditions. To such rigidity of mind have the majority of educational leaders been reduced

by the ideal of regimentation and the fetish-worship of system and uniformity that they are honestly incapable of realizing the individualist attitude or of sympathizing with the more humane and rational principles which we have endeavored to set forth. Jealous enough of professional privilege on their own account, they take a slighting view of the equally valid claims to professional consideration made by the body of actual teachers. They are so impressed by their smoothly-working machinery as to forget completely that the fashioning of souls is a very different affair from the manufacture of watches or other products of the mechanic arts. To their view, the alternative offered in place of their elaborate systems of executive control and the graded devolution of authority may well seem to deserve the name of chaos, but intelligent minds will not be terrified by a word which means, in this instance and in the last analysis, nothing more than a recognition of the fact that teachers and students are alike individuals, and that prescription *en masse* is the poorest possible way of dealing with difficulties that concern individuals alone.

Aside from the cry of chaos, every plea for the rehabilitation of the teaching profession is sure to be met by the assertion that large numbers of those engaged in it are unfit for the burden of professional responsibility. This is probably true. It would be surprising if it were not true, when we consider the meagerness of the rewards hitherto held out to the rank and file of the profession, and the constant growth of the regulative tendency which unfailingly operates to deter the best men from becoming teachers, and to drive from the ranks the best of those already enlisted. The situation, moreover, as respects the sort of ability, the type of outstanding personality, most to be desired, tends constantly to grow worse rather than better through the continuous operation of the same malign influences. But was there ever a more vicious circle of argument than that which defends the persistence in a system productive of such unfortunate results by urging that the personnel of the profession has now been brought so low that the restoration of its in-

herent rights would entail disastrous consequences? Very possibly it would, and evils of this sort might have to be faced, but they would be in their nature temporary, and not nearly as disheartening as the lasting and deepening evils involved in the perpetuation of an administrative policy which is an affront to every professional instinct. Professor Joseph Jastrow, in a remarkably forceful and enlightened discussion of this subject in its bearings upon university administration (SCIENCE, April 13), puts the whole matter in a nutshell when he declares for the substitution of 'government by cooperation' for 'government by imposition.' This is surely the ideal toward which everyone having at heart the interests of education as a professional matter should strive, in fields both high and low, and we have observed numerous recent indications of a reaction in this sense from the military or corporate ideal which has hitherto had things its own way. But the enemy is still strongly intrenched, and his position will not easily be forced.—*The Dial*.

THE GEOLOGICAL SURVEY.

THE National Geological Survey has properly taken alarm at the radical cut which Mr. Tawney, the new chairman of the House committee, has made in the appropriation for its work. He proposes to reduce the annual charge from \$1,400,000 to \$1,050,000, a cut which falls with especial severity upon certain of the survey's operations. The allowance for the measurement of streams for water-power purposes and to aid in settling other questions of municipal and domestic importance, in which New England is so vitally interested, has been cut from \$200,000 to half that sum. The coal-testing plant at St. Louis, recently described in the *Transcript*, will be asked to get along on half rations. The division of mineral resources, and the Topographical Survey, have also felt the committee's pruning knife.

While it has long been evident that the Geological Survey was expanding far too rapidly, in common with various other functions of government, so radical a cut as this is neither necessary nor desirable. The sur-

vey has trained its own scientists for their various lines of work, and such a reduction as Mr. Tawney proposes would break up a corps that could not in years be reassembled. In view of the expenditures for war, like the \$100,000,000 a year in time of profound peace, for the navy, it seems little short of ridiculous to be disturbed over a great civil establishment, whose work is counting for civilization and progress in a score of directions, at an annual cost which equals that of the navy for only four days. So long as the government can spend freely for some things, it seems unreasonable to hold other agencies down to the strict rules of economy. The survey is now moving vigorously to get the House or, if not that body, certainly the Senate, to restore its appropriation, in part, at least. Every new chairman of the appropriations committee makes a similar attempt. Mr. Cannon did, when he went into that service, and so did Mr. Hemenway, and now comes Mr. Tawney.

The national irrigation enterprise which is conducted by the Geological Survey, though not carried in its appropriations, is now at full tide. More ditch digging is probably in progress under its direction than at Panama, for the records show that the reclamation service is employing four thousand persons directly, and that the contractors working under it employ seven thousand more. Irrigation expenses have now reached one million dollars a month, paid for by the sales of public land, and at this rate expenditure will go on, it is safe to predict, for some years. These enterprises bring differing problems, and although no one of them is so difficult as that at Panama, they present in the aggregate questions to be solved, engineering, mechanical and financial, probably not less serious than at the Isthmus.—*The Boston Transcript*.

ASTRONOMICAL NOTES.

SUGGESTIONS FOR A THEORY OF THE MILKY WAY AND THE CLOUDS OF MAGELLAN.

MR. ARTHUR R. HINKS, of Cambridge, England, has published an interesting pamphlet on 'Suggestion for a Theory of the Milky